**APPLY BASIC EXERCISE SCIENCE TO EXERCISE INSTRUCTION**

**THEORY WORKBOOK**

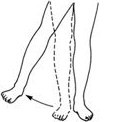
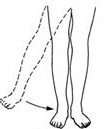
**VCE / VET**

**FITNESS FOCUS – BUNDLE ONE**

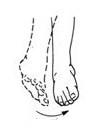
**Competencies addressed in this workbook task**

* **SRFFIT005B:** 
  + **Apply Basic Exercise Science to Exercise Instruction**
    - **Element One – Use anatomical terminology and descriptions of the musculoskeletal structure of the body when instructing clients.**
* Apply the ***components of fitness*** and the function of the body systems to common fitness activities
* Use ***anatomical terminology*** and describe and demonstrate movements of the body to clients
* Relate the location and function of the ***major bones*** of the upper and lower extremities and axial skeleton to movement when instructing clients
* Relate the structure and function of the ***major joints*** of the body to exercise to movement when instructing clients
* Relate the gross structure of skeletal muscle and its relationship to movement to movements when instructing clients
* Relate ***major muscles*** and their prime moving movements at major ***joints*** in the body to movement when instructing clients.
* Relate the neural control of skeletal muscle contraction to movement when instructing clients
* Relate basic types of ***neural feedback*** involved in the coordination of movement to movement when instructing clients
* Measure and relate the relationship between muscle size and strength to movement when instructing clients
* Explain the basic structural adaptations to musculoskeletal tissue that occur as a result of fitness training to clients

1. **ANATOMICAL TERMINOLOGY**
2. In the diagrams below identify the anatomical movements



13 marks

**Muscular System**

Muscles make up the bulk of an animal’s body and account for about half its weight. The meat on the chop or roast is muscle and is composed mainly of protein. The cells that make up muscle tissue are elongated and able to contract to a half or even a third of their length when at rest. There are three different kinds of muscle; smooth, cardiac and skeletal muscle.

**Smooth muscle**

Smooth or Involuntary muscle carries out the unconscious routine tasks of the body such as moving food down the digestive system, keeping the eyes in focus and adjusting the diameter of blood vessels. The individual cells are spindle-shaped, being fatter in the middle and tapering off towards the ends with a nucleus in the centre of the cell. They are usually found in sheets and are stimulated by the non-conscious or autonomic nervous system as well as by hormones

**Cardiac muscle**

Cardiac muscle is only found in the wall of the heart. It is composed of branching fibres that form a three-dimensional network. When examined under the microscope, a central nucleus and faint stripes or striations can be seen in the cells. Cardiac muscle cells contract spontaneously and rhythmically without outside stimulation but the pacemaker coordinates the heart beat. Nerves and hormones modify this rhythm

**Skeletal muscle**

Skeletal muscle is the muscle that is attached to and moves the skeleton, and is under voluntary control. It is composed of elongated cells or fibres lying parallel to each other. Each cell is unusual in that it has several nuclei and when examined under the microscope appears striped or striated. This appearance gives the muscle its names of striped or striated muscle. Each cell of striated muscle contains hundreds, or even thousands, of microscopic fibres each one with its own striped appearance. The stripes are formed by two different sorts of protein that slide over each other making the cell contract

Skeletal muscles are probably the most familiar type of muscle to people. Skeletal muscles are the ones that ache when someone goes for that first outdoor run in the spring after not running much during the winter. And skeletal muscles are heavily used when someone carries in the grocery bags. [**Exercise**](http://science.jrank.org/pages/2630/Exercise.html) may increase muscle fiber size, but muscle fibre number generally remains constant. Skeletal muscles take up about 40% of the body's [**mass**](http://science.jrank.org/pages/4154/Mass.html), or weight. They also use a great deal of [**oxygen**](http://science.jrank.org/pages/4970/Oxygen.html) and [**nutrients**](http://science.jrank.org/pages/4801/Nutrients.html) from the [**blood supply**](http://science.jrank.org/pages/970/Blood-Supply.html). Multiple levels of skeletal muscle [**tissue**](http://science.jrank.org/pages/6847/Tissue.html) receive their own blood supplies.

Skeletal muscles fibres are characterized as "fast" or "slow" based on their activity patterns. Fast, also called "white," muscle fibres contract rapidly, have poor blood supply, operate anaerobically, and fatigue rapidly. Slow, also called "red," muscle fibres contract more slowly, have better blood supplies, operate aerobically, and do not fatigue as easily. Slow muscle fibres are used in movements that are sustained, such as maintaining posture.

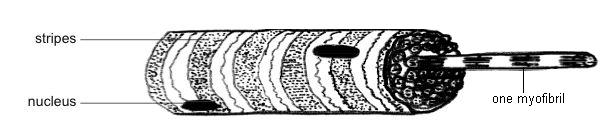
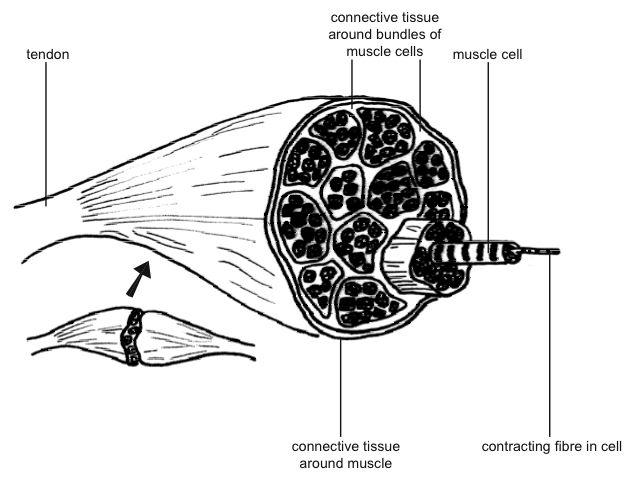
[](http://en.wikibooks.org/wiki/Image:Anatomy_and_physiology_of_animals_Striped_muscle_cell.jpg)

Diagram - A striped muscle cell

**Muscle contraction**

Muscle contraction requires energy and muscle cells have numerous mitochondria. However, only about 15% of the energy released by the mitochondria is used to fuel muscle contraction. The rest is released as heat. This is why exercise increases body temperature and makes animals sweat or pant to rid themselves of this heat.

What we refer to as a muscle is made up of groups of muscle fibres surrounded by connective tissue. The connective tissue sheaths join together at the ends of the muscle to form tough white bands of fibre called **tendons**. These attach the muscles to the bones. Tendons are similar in structure to the **ligaments** that attach bones together across a joint (see diagrams 7.2a and b).

[](http://en.wikibooks.org/wiki/Image:Anatomy_and_physiology_of_animals_Structure_of_a_muscle.jpg)

The structure of a muscle

Remember:

**Tendons Tie** muscles to bones

and

**Ligaments Link** bones at joints

**Structure of a muscle**

A single muscle is fat in the middle and tapers towards the ends. The middle part, which gets fatter when the muscle contracts, is called the **belly** of the muscle. If you contract your biceps muscle in your upper you may feel it getting fatter in the middle. You may also notice that the biceps is attached at its top end to bones in your shoulder while at the bottom it is attached to bones in your lower arm. Notice that the bones at only one end move when you contract the biceps. This end of the muscle is called the **insertion**. The other end of the muscle, the **origin**, is attached to the bone that moves the least

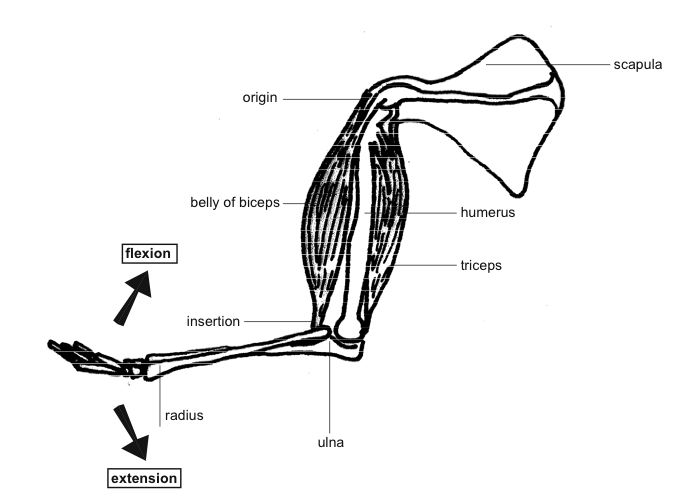
[](http://en.wikibooks.org/wiki/Image:Anatomy_and_physiology_of_animals_Antagonistic_muscles,_flexion&tension.jpg)

Diagram - Antagonistic muscles, flexion and extension

**Antagonistic muscles**

Skeletal muscles usually work in pairs. When one contracts the other relaxes and vice versa. Pairs of muscles that work like this are called **antagonistic muscles**. For example the muscles in the upper forearm are the biceps and triceps. Together they bend the elbow. When the biceps contracts (and the triceps relaxes) the lower forearm is raised and the angle of the joint is reduced. This kind of movement is called **flexion**. When the triceps is contracted (and the biceps relaxes), the angle of the elbow increases. The term for this movement is **extension**.

When you or animals contract skeletal muscle it is a voluntary action. For example, you make a conscious decision to walk across the room, raise the spoon to your mouth or smile. There is however, another way in which contraction of muscles attached to the skeleton happens that is not under voluntary control. This is during a **reflex action**, such as jerking your hand away from the hot stove you have touched by accident. This is called a **reflex arc**.

**Summary**

* There are three different kinds of muscle tissue: **smooth muscle** in the walls of the gut and blood vessels; **cardiac muscle** in the heart and **skeletal muscle** attached to the skeleton.
* **Tendons** attach skeletal muscles to the skeleton.
* **Ligaments** link bones together at a joint.
* Skeletal muscles work in pairs known as **antagonistic pairs.** As one contracts the other in the pair relaxes.
* **Flexion** is the movement that reduces the angle of a joint. **Extension** increases the angle of a joint.

2. What kind of muscle tissue:

a) moves bones: \_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_

b) makes the heart pump blood: \_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_

c) pushes food along the intestine: \_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_

d) makes your mouth form a smile: \_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_

e) makes the hair stand up when cold: \_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_

f) makes the diaphragm contract for breathing in: \_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_ 6 marks

3. What structure connects a muscle to a bone? \_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_ 1 mark

4. What is the insertion of a muscle? \_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_ 1 mark

5. Which muscle is antagonistic to the biceps? \_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_ 1 mark

6. When you flex your knee what movement are you making? \_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_

\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_ 1 mark

7. When you extend your ankle joint what happens? \_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_

\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_ 1 mark

**Skeletal muscles**



Muscle Three

Muscle Two

Muscle One

8. In the above diagram, identify:

1. The muscle responsible for flexion at the elbow \_\_\_\_\_\_\_\_\_\_\_\_\_
2. Which muscle is the antagonist in this action? \_\_\_\_\_\_\_\_\_\_\_\_\_\_
3. Name Muscle One \_\_\_\_\_\_\_\_\_\_\_\_\_\_
4. Name Muscle Two \_\_\_\_\_\_\_\_\_\_\_\_\_\_
5. Name Muscle Three\_\_\_\_\_\_\_\_\_\_\_\_\_\_ 5 marks



Muscle Two

Muscle One

Muscle Group

9. In the diagram above, identify:

1. The agonist muscle performing flexion at the knee (left leg) \_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_
2. The antagonist muscle in this action \_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_
3. Identify the muscle group \_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_
4. Identify Muscle One \_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_
5. Identify Muscle Two \_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_ 5 marks

10. List 3 sports that would predominantly use “fast twitch” muscle fibres

\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_

3 marks

11. List 3 sports that would predominantly use “slow twitch” muscle fibres

\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_

3 marks

12. Over an 8 week weights training program, a client notices that his bicep muscle is getting bigger. Is this due to an increase in muscle fibre size or an increase in the number of muscle fibres in the biceps?

\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_

\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_

2 marks



F

E

D

C

B

A

13. Identification of origins and insertions of muscles

1. The origin of the biceps is at point \_\_\_\_\_\_\_
2. The insertion of the quadriceps is at point \_\_\_\_\_\_\_\_\_
3. The origins of the forearm extensors is at point \_\_\_\_\_\_\_\_\_
4. The insertion of the gastrocnemius is at point \_\_\_\_\_\_\_\_\_\_\_ 4 marks

**Superficial Muscles**

14. Label the muscles on the diagrams below – 16 marks

**Proprioceptors**

The nerve endings that relay all the information about the musculoskeletal system to the central nervous system are called proprioceptors. Proprioceptors (also called mechanoreceptors) are the source of all proprioception: the perception of one's own body position and movement. The proprioceptors detect any changes in physical displacement (movement or position) and any changes in tension, or force, within the body. They are found in all nerve endings of the joints, muscles, and tendons. The proprioceptors related to stretching are located in the tendons and in the muscle fibres.

Muscle spindles, or stretch receptors, are the primary proprioceptors in the muscle. Another proprioceptor that comes into play during stretching is located in the tendon near the end of the muscle fibre and is called the Golgi tendon organ. A third type of proprioceptor, called a pacinian corpuscle, is located close to the Golgi tendon organ and is responsible for detecting changes in movement and pressure within the body.

The muscle spindle contains two different types of fibres (or stretch receptors) which are sensitive to the change in muscle length and the rate of change in muscle length. When muscles contract it places tension on the tendons where the Golgi tendon organ is located. The Golgi tendon organ is sensitive to the change in tension and the rate of change of the tension.

**Feedback Loops (Stretch Reflex)**

Skeletal muscle contains motor and sensory fibres from the central nervous system. Some of these form complex feedback loops. Receptors in the muscle body provide information and the length of the muscle and its tension. This is conducted to the spinal cord and to higher levels of the central nervous system. The ‘knee-jerk reflex’ is a well known example of a feedback loop, which is made possible by a neural circuit between the stretch receptors in the muscle spindles and the motor neurons in the spinal cord. When the muscle is lengthened the stretch reflex comes into operation causing the muscle to contract – that is, the reflex opposes the lengthening of the muscle. The Golgi tendon senses muscle tension and form a negative feedback system that prevents damaging levels of tension from building up in the muscle and possibly damaging the muscle fibres or the insertion of the tendons.

Positive and negative feedback comes from receptors in the muscles and forms a feedback loop at the spinal cord. A contraction/relaxation reflex exists between antagonist muscles; when one contracts, the other relaxes to allow movement at the joint. The reflex depends on the feedback from the muscle spindles and the Golgi tendon bodies, respectively.

Certain reflexes occur in response to dangerous stimuli, such as extreme [**heat**](http://science.jrank.org/pages/3262/Heat.html). Reflexive skeletal muscular movement is controlled at the level of the spinal cord and does not require higher brain initiation. Reflexive movements are processed at this level to minimize the amount of [**time**](http://science.jrank.org/pages/6844/Time.html) necessary to implement a response.

15. Which stretch receptor is sensitive to changes in the length and rate of change in muscle length?

\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_ 1 mark

16. Which stretch receptor is sensitive to changes in the tension in the muscle and the rate of change of tension?

\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_ 1 mark

17. List the 3 proprioceptors in the musculoskeletal system.

\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_

3 marks

18. Give a brief definition of proprioception

\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_

1 marks

19. When performing a leg extension exercise on a machine, briefly explain how the body ‘knows’ where all parts of the leg are during the exercise.

­­­­­­­­­­­­­­­­­­­­­­­­­­­­­­­­­­­\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_

\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_

\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_

\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_

­­­­­­­­­­­­­­­­­­­­­­­­­­­­­­­­­­­\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_

\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_

\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_

\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_

5 marks

**Muscle hypertrophy** is a muscle enlargement, which can be helpful for you in producing greater force.

It is most valuable for athletes, who are mostly concerned with performance in certain events, which require more strength and power.

However, *resistance training* can improve your muscle enlargement and it is very essential for you to frame a proper workout in order to meet your goal. There are two important things which you need to know during this muscle hypertrophy.

First one is, up to what extent cellular adaptations can be responsible for muscle hypertrophy and the other is the type of resistance which you need to engage yourself in order to ensure maximum *muscle hypertrophy*.

**Contributions at cellular level to get maximum muscle hypertrophy:**

Before you undergo any training for muscle hypertrophy, it is very essential for you to know what’s happening inside the deeper layers of muscles, so that you can workout better to get desired muscle strength.

Small actins and myosin filaments are the main protein elements responsible for your muscle contraction, which combine together to create a cross sliding bridges to produce greater force.

More than thousands of these filaments are present inside your muscle fibres, which mainly contribute for your muscle enlargement. The more the cross bridges are attached, the greater the force will be produced and therefore your power output capabilities are also increased.

**Gaining muscle mass** without using any [steroids or artificial supplements](http://www.fitnesshealthzone.com/vitamins-supplements/how-to-choose-the-right-fitness-supplements-safety-guidelines-to-guide-you-when-buying-supplements/) require a lot of discipline and commitment to your training and also you should follow a strict balanced diet.

It is very important for you to re-evaluate your routine schedule and set aside sometime for workouts regularly in gym and also to make essential changes in your regular diet.

So, in order to gain muscle mass as faster as possible, here are certain important tips, which can be helpful for you.

**Increase your calorie intake!**

***Proteins*** play a vital role in *gaining muscle mass* and also 100% calories are obtained from your protein intake. So it would not be possible for you to gain even an ounce of muscle, if your overall intake of calories is not greater than your daily calorie output.

To gain proper *muscle mass*, your body requires a well [*balanced diet*](http://www.fitnesshealthzone.com/diet-nutrition/how-to-achieve-balanced-diet-to-stay-fit-and-healthy/) that can provide approximately 300-500 more calories than your regular calorie intake level. A diet which provides 10 to 15 percent of calories from proteins is sufficient for your body, which can help you in gaining muscle mass.

**Weight resistance training necessary for you to gain muscle mass!**

Regular weight resistance exercises at your gym are very essential in gaining muscle mass. Before you practice these exercises, try to consult an experienced fitness instructor and take proper suggestions. Careless or improper handling of weights can actually cause injuries for your body.

**Essential tips in weight training which aids to gain muscle mass:**

While practicing *weight training exercises*, try to work on larger muscle groups. They are actually best suitable in *gaining muscle mass*. Try to avoid extreme lateral raises and step ups as they are not recommended for gaining muscle mass.

Gradually try to add more weights as you progress in your weight training exercises. This will help you to develop more strength and also builds up those muscles on which you are working.

Try low reps with very heavy weights and make sure to take 3 minutes rest between each set of exercise and three workouts for each body part is enough.

20. A client wants to increase the ‘size’ of their muscles. Briefly describe how you would explain the term ‘hypertrophy’ to your client.

\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_

\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_

\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_

2 marks

21. List the key elements you would include in advising your client and devising a weight training program for them.

\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_

\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_

\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_

\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_

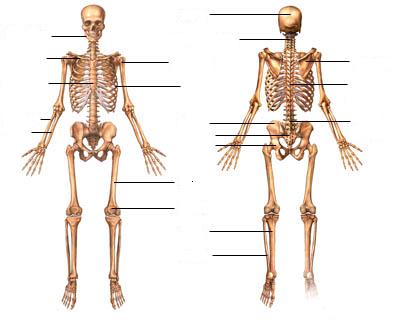
\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_

\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_

5 marks

**Skeletal System and Articulations**

22. Label the diagrams below – 23 marks



The skeletal system ([bones](http://webschoolsolutions.com/patts/systems/skeleton.htm#class) and [joints](http://webschoolsolutions.com/patts/systems/skeleton.htm#joints)), working interdependently with the [*skeletal* muscle system](http://webschoolsolutions.com/patts/systems/muscles.htm#musculoskeletal) ([voluntary or striated muscles](http://webschoolsolutions.com/patts/systems/muscles.htm#types)), provides basic functions that are essential to life:

* Protection: protects the brain and internal organs
* Support: maintains upright posture
* Blood cell formation: *hematopoiesis*
* Mineral homeostasis
* Storage: stores fat and minerals.
* Leverage: A lever is a simple machine that magnifies speed of movement or force. The [levers are mainly the long bones of the body](http://webschoolsolutions.com/patts/systems/skeleton.htm#class) and the [axes (fulcrum) are the joints](http://webschoolsolutions.com/patts/systems/skeleton.htm#joints) where the bones meet.

**JOINTS**A joint, or articulation, is where two or more bones meet and also often where movement occurs.

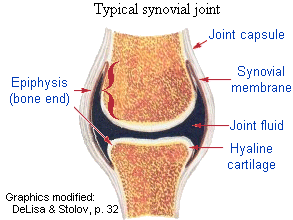
There are over 100 different types of joint but they are generally linked together by the amount of movement which they allow.   
The moveable joints in the body permit different kinds of movement.   
The type, direction and amount of movement is governed by the limitations (structure) of the joint.  
  
**TYPES OF JOINTS**There are three main different types of joint.  
  
**Immovable or Fibrous joints**These are very stable and allow no observable movement. Bones are often joined by strong fibres called sutures; eg, the sutures of the cranium.

**Slightly movable joints or Cartilaginous**A cartilaginous joint allows some slight movement. The ends of bones, which are covered in articular or hyaline cartilage, are separated by pads of white fibrocartilage and slight movement is made possible only because the pads of cartilage compress.   
In addition, the pads of cartilage act as shock absorbers.   
The intervertebral discs are examples of this type of joint.

**Freely movable joints or Synovial joints**A synovial joint is a freely moving joint, and is the most common type of joint in the body, and the most important in terms of physical activity, since they allow a wide range of movement. These types of joint are divided up according to the movement that they make possible. Surrounding the joint is a membrane called the Synovial Membrane which is where Synovial fluid is formed. This fluid acts as a lubricator and is formed within the joint AND allows friction free movement. A good example of this is the knee joint.

A typical synovial joint, seen at right, has four main features:

1. *joint capsule* -  the joint enclosure, reinforced by and strengthened with ligaments
2. *synovial membrane* -  a continuous sheet of connective tissue lining the capsule; its cells produce synovial fluid that lubricates the joint and prevents the two cartilage caps on the bones from rubbing together
3. *synovial fluid* - produced by the synovial membrane, the fluid lubricates the joint. In the normal joint, very little fluid (less than 5cc) exists in the cavity.
4. *hyaline (articular) cartilage* - where the bones actually "meet"



**THE DIFFERENT TYPES OF SYNOVIAL JOINTS**

There are six types of synovial joints. Some are relatively immobile, but are more stable. Others have multiple degrees of freedom, but at the expense of greater risk of injury. In ascending order of mobility, they are:

|  |  |  |
| --- | --- | --- |
| **Name** | **Example** | **Description** |
| [*Gliding joints*](http://en.wikipedia.org/wiki/Gliding_joint) (or *planar joints*) | the [carpals](http://en.wikipedia.org/wiki/Carpal) of the [wrist](http://en.wikipedia.org/wiki/Wrist) | These joints allow only gliding or sliding movements. |
| [*Hinge joints*](http://en.wikipedia.org/wiki/Hinge_joint) | the [elbow](http://en.wikipedia.org/wiki/Elbow-joint) (between the [humerus](http://en.wikipedia.org/wiki/Humerus) and the [ulna](http://en.wikipedia.org/wiki/Ulna)) | These joints act like a [door](http://en.wikipedia.org/wiki/Door) [hinge](http://en.wikipedia.org/wiki/Hinge), allowing flexion and extension in just one plane. |
| [*Pivot joints*](http://en.wikipedia.org/wiki/Pivot_joint) | the elbow (between the [radius](http://en.wikipedia.org/wiki/Radius_(bone)) and the [ulna](http://en.wikipedia.org/wiki/Ulna))The Knee | This is where one bone rotates about another. |
| [*Condyloid joints*](http://en.wikipedia.org/wiki/Condyloid_joint) (or *ellipsoidal joints*) | the [wrist](http://en.wikipedia.org/wiki/Wrist) | A condyloid joint is where two bones fit together with an odd shape (e.g. an [ellipse](http://en.wikipedia.org/wiki/Ellipse)), and one bone is concave, the other convex. Some classifications make a distinction between condyloid and ellipsoid joints. |
| [*Saddle joints*](http://en.wikipedia.org/wiki/Saddle_joint) | the [thumb](http://en.wikipedia.org/wiki/Thumb) (between the [metacarpal](http://en.wikipedia.org/wiki/Metacarpal) and [carpal](http://en.wikipedia.org/wiki/Carpal)) | Saddle joints, which resemble a [saddle](http://en.wikipedia.org/wiki/Horse_tack), permit the same movements as the condyloid joints. |
| [*Ball and socket joints*](http://en.wikipedia.org/wiki/Ball_and_socket_joint) | the [shoulder](http://en.wikipedia.org/wiki/Shoulder) and [hip](http://en.wikipedia.org/wiki/Hip) joints | These allow a wide range of movement. |

23. List 6 functions of the skeletal system – 6 marks

\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_

\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_

\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_

\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_

\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_

\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_

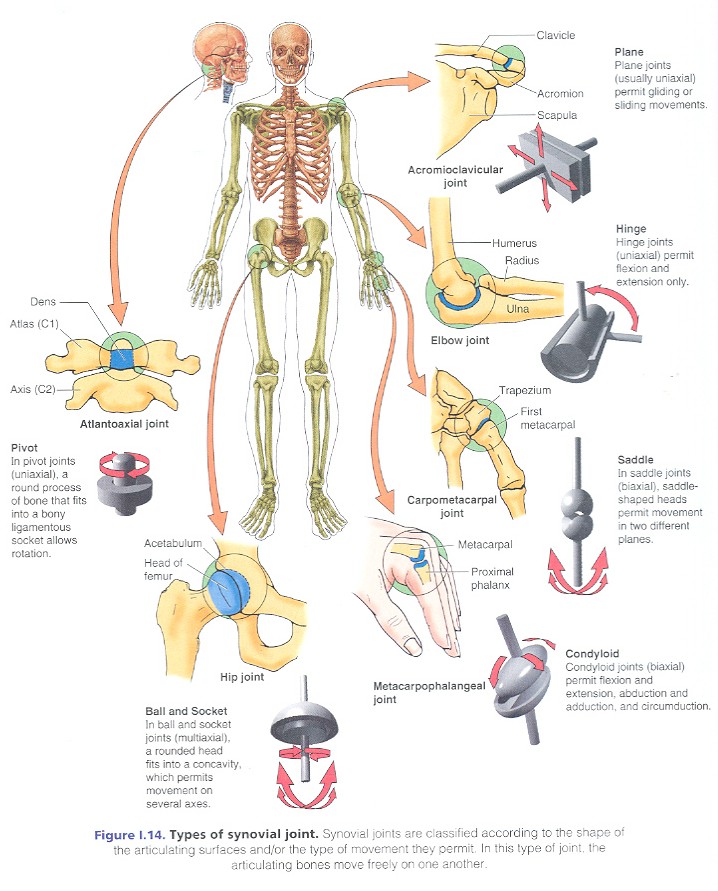
24. List the 4 main components of a synovial joint – 4 marks

\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_

\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_

\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_

\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_



25. Which type of synovial joint allows the greatest movement?

\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_

1 mark

26. Name 2 of these joints from the previous question

\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_

2 marks

27. Which type of synovial joint allows only flexion and extension?

\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_

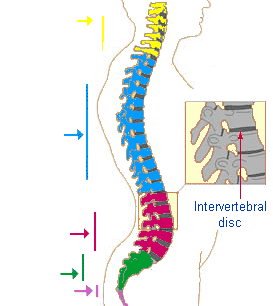
1 mark

28. Name 2 of these joints from the previous question

\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_

2 marks

**The Vertebral Column**



29. Identify the regions of the Vertebral Column

1. \_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_
2. \_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_
3. \_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_
4. \_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_
5. \_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_

5 marks

E

D

C

B

A

**Conditioning**

One of the misconceptions in the sports world is that a sports person gets in shape by just playing or taking part in his/her chosen sport. If a stationary level of performance, consistent ability in executing a few limited skills is your goal, then engaging only in your sport will keep you there. However, if you want the utmost efficiency, consistent improvement, and balanced abilities sportsmen and women must participate in year round conditioning programs.

The bottom line in sports conditioning and fitness training is stress, not [mental stress](http://www.brianmac.co.uk/stress.htm), but adaptive body stress. Sportsmen and women must put their bodies under a certain amount of stress ([overload](http://www.brianmac.co.uk/trnprin.htm)) to increase physical capabilities.

**The Components of Fitness**

Health is a state of complete mental, physical and social well being where as fitness is the ability to meet the demands of a physical task.

Basic fitness can be classified in four main components: strength, speed, stamina and flexibility. However, exercise scientists have identified nine components that comprise the definition of fitness:

* [**Strength**](http://www.brianmac.co.uk/strength.htm) - the extent to which muscles can exert force by contracting against resistance (e.g. holding or restraining an object or person)
* [**Power**](http://www.brianmac.co.uk/power.htm) - the ability to exert maximum muscular contraction instantly in an explosive burst of movements. The two components of power are strength and speed. (e.g. jumping or a sprint start)
* [**Agility**](http://www.brianmac.co.uk/agility.htm) - the ability to perform a series of explosive power movements in rapid succession in opposing directions (e.g. ZigZag running or cutting movements)
* [**Balance**](http://www.brianmac.co.uk/agility.htm) - the ability to control the body's position, either stationary (e.g. a handstand) or while moving (e.g. a gymnastics stunt)
* [**Flexibility**](http://www.brianmac.co.uk/mobility.htm) - the ability to achieve an extended range of motion without being impeded by excess tissue, i.e. fat or muscle (e.g. executing a leg split)
* [**Local Muscle Endurance**](http://www.brianmac.co.uk/enduranc.htm) - a single muscle's ability to perform sustained work (e.g. rowing or cycling)
* [**Cardiovascular Endurance**](http://www.brianmac.co.uk/enduranc.htm) - the heart's ability to deliver blood to working muscles and their ability to use it (e.g. running long distances)
* [**Strength Endurance**](http://www.brianmac.co.uk/enduranc.htm) - a muscle's ability to perform a maximum contraction time after time (e.g. continuous explosive rebounding through an entire basketball game)
* [**Co-ordination**](http://www.brianmac.co.uk/coord.htm)- the ability to integrate the above listed components so that effective movements are achieved.

Of all the nine elements of fitness [cardiac respiratory](http://www.brianmac.co.uk/vo2max.htm) qualities are the most important to develop as they enhance all the other components of the conditioning equation.

**Physical Fitness**

Physical fitness refers to the capacity of an athlete to meet the varied physical demands of their sport without reducing the athlete to a fatigued state. The components of physical fitness are:

* [Strength](http://www.brianmac.co.uk/strength.htm)
* [Endurance](http://www.brianmac.co.uk/enduranc.htm)
* [Speed](http://www.brianmac.co.uk/speed.htm)
* [Flexibility](http://www.brianmac.co.uk/mobility.htm)
* [Body Composition](http://www.brianmac.co.uk/bodytype.htm)

**Motor Fitness**

Motor Fitness refers to the ability of an athlete to perform successfully at their sport. The components of motor fitness are:

* [Agility](http://www.brianmac.co.uk/agility.htm)
* [Balance](http://www.brianmac.co.uk/agility.htm)
* [Co-ordination](http://www.brianmac.co.uk/agility.htm)
* [Power](http://www.brianmac.co.uk/power.htm)
* [Reaction Time](http://www.brianmac.co.uk/reaction.htm)

**Improving your condition**

Identify the most important fitness components for success in your sport or event and then design sport/event specific conditioning and [training programs](http://www.brianmac.co.uk/plant.htm) that will enhance these fitness components and [energy systems](http://www.brianmac.co.uk/energy.htm).

30. For each of the nine main components of fitness identified, list a fitness test and a sporting activity that would required this component to be well developed.

* [**Strength**](http://www.brianmac.co.uk/strength.htm) – \_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_ 1 mark
* [**Power**](http://www.brianmac.co.uk/power.htm) – \_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_ 1 mark
* [**Agility**](http://www.brianmac.co.uk/agility.htm) - \_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_ 1 mark
* [**Balance**](http://www.brianmac.co.uk/agility.htm) – \_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_ 1 mark
* [**Flexibility**](http://www.brianmac.co.uk/mobility.htm) - \_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_ 1 mark
* [**Local Muscle Endurance**](http://www.brianmac.co.uk/enduranc.htm) - \_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_ 1 mark
* [**Cardiovascular Endurance**](http://www.brianmac.co.uk/enduranc.htm) – \_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_ 1 mark
* [**Strength Endurance**](http://www.brianmac.co.uk/enduranc.htm) – \_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_ 1 mark
* [**Co-ordination**](http://www.brianmac.co.uk/coord.htm)- \_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_ 1 mark

**The Overload Principle**

This is probably the most important principle of exercise and training. Simply stated, the Overload Principle means that the body will adapt to the stresses placed upon it. The more you do, the more you are capable of doing.  This is how all the training adaptations occur in exercise and training.  The human body is an amazing machine. When you stress the body through lifting a weight that the body is unaccustomed to lifting, the body will react by causing physiologic changes to be able to handle that stress the next time it occurs.  This concept is similar in cardiovascular training.  If you ask the heart, lungs and endurance muscles to do work not previously done, it will make changes to the body to be able to handle that task better the next time. This is how people get stronger, bigger, faster and increase their physical fitness level.

When you are working out, you want to strive to somehow increase the workload you are doing above what you did on your previous workout so you have overloaded your body to create a training adaptation.  This increase in workout stress can be a very small increase, as many small increases over time will eventually be a large increase or adaptation.

**The stress placed upon the body in a workout relates to numerous factors such as:**

|  |
| --- |
| * Amount of Time to Accomplish the Workout * Amount of Force Generated During the Workout * Amount of Total Workload in a Training Session |

Some ways to increase the workload of a training session over a previous workout session include:

**Decrease Workout Time**

If you perform the same exact workout on two days, but on one day it took less time, you have increased the workload on the day that it took less time for the workout.  This is due to the fact that time is a component of determining workload, therefore; you have increased the **intensity** of the workout by decreasing the amount of time to complete it.

**Increase Force Generated During an Exercise**

This can be as simple as adding more weight or resistance to an exercise or to the body as in cycling, running or stair climbing. Adding just a small increase in weight, resistance or incline, whenever possible, to an exercise will soon accumulate to large gains in workload performed. Other methods to increase force include performing exercises with accelerating speed and a greater range of motion.

**Increase Total Workload**

Some examples of increasing a training session workload include doing more exercises, doing more sets, going farther or going faster. Some of these benefits can be offset by a corresponding substantial increase in time to perform the increased workload as time is a component in work performed. The goal is to increase work while decreasing time to a point that determines a maximum workload for a training session.   This provides for **maximum intensity** and efficient, productive training.

Remember, if you do not stress the body enough it will **atrophy** (deteriorate) to the point it needs to perform normal daily functioning and nothing more.  Hence the aging process!

31. How can you apply the Overload Principle to a client’s exercise program?

\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_

\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_

\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_

\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_

\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_ 4. marks

32. Select 3 components of fitness and describe how you would apply the Overload Principle to an exercise utilising each of these components.

\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_

\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_

\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_

\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_

\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_

\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_

\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_

\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_

\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_

\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_

\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_

\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_

\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_

\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_

\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_

\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_

\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_

\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_

9 marks